WHAT WE CLAIM IS:

1. A double-sided electrode-free resonator device, comprising:

a double-sided mesa resonator plate with a top surface, a top well, a mesa, a bottom well and a bottom surface;

a top electrode, being deposited on said top surface and having a top narrow portion and a top wide portion, extends into said top well surrounding said mesa, allowing said mesa to protrude upwards;

a bottom electrode, being deposited on said bottom surface and having a bottom narrow portion and a bottom wide portion, extends into said bottom well surrounding said mesa, allowing said mesa to protrude downwards;

said mesa providing an electrode-free resonator area;

a resonator is provided in said resonator area, said resonator having a top resonator portion, a bottom resonator portion and a resonator thickness dimension, t_3, measured from said top resonator portion to said bottom resonator portion;

an exposed top portion of the mesa situated between said resonator and said resonator area defines a first acoustic gap, l_7, and an exposed bottom portion of the mesa situated between said resonator and said resonator area defines a second acoustic gap, l_7;

said top electrode and said bottom electrode, being acoustically coupled and controlled by said first and second acoustic gaps, generate an electro-magnetic field between said electrodes causing an excitation voltage within a vibrating area of said resonator plate, that generates an acoustic energy within said resonator plate; and

said resonator having a resonator frequency determined by said resonator thickness dimension, t_3, said resonator area provides an active element trapping said acoustic energy, causing said acoustic energy to be confined to said resonator area to minimize a leakage of said acoustic energy and provide a high Q factor at 3GHz.

2. The double-sided electrode-free resonator device, as recited in claim 1, further comprising said top electrode having an electrode length, l_2, and an electrode width, w_2.

3. The double-sided electrode-free resonator device, as recited in claim 2, further comprising said resonator having a resonator length, l_3, and a resonator width, w_3.

4. The double-sided electrode-free resonator device, as recited in claim 3, further comprising said bottom electrode being configured the same as said top electrode.

5. The double-sided electrode-free resonator device, as recited in claim 4, further comprising said bottom electrode having said electrode length, l_2, and said electrode width, w_2.

6. The double-sided electrode-free resonator device, as recited in claim 5, further comprising said electrode length l_2 being greater than said resonator length l_3.

7. The double-sided electrode-free resonator device, as recited in claim 6, further comprising said electrode width w_2 being greater than said resonator width w_3.

8. The double-sided electrode-free resonator device, as recited in claim 7, further comprising adjusting said resonator thickness dimension, t_3, to vary said resonator frequency.

9. The double-sided electrode-free resonator device, as recited in claim 8, further comprising fabricating said resonator plate with an etching process.

10. The double-sided electrode-free resonator device, as recited in claim 9, further comprising said resonator plate being composed of quartz.

11. The double-sided electrode-free resonator device, as recited in claim 10, wherein said resonator plate is a quartz crystal.

12. A single-sided electrode-free resonator device, comprising:

a single-sided monolithic mesa resonator plate with a top surface, a well, a mesa and a bottom surface;

a top electrode, being deposited on said top surface, extends into said well surrounding said mesa, allowing said mesa to protrude upwards, and provide an electrode-free resonator area;

a resonator is provided in said resonator area, said resonator having a resonator thickness dimension, t_3, measured from said resonator to said bottom surface;

a bottom electrode, having a narrow portion and a wide portion, is deposited on said bottom surface;

an exposed portion of the mesa situated between said resonator and said resonator area defines an acoustic gap, l_7;

said top electrode and said bottom electrode, being acoustically coupled and controlled by said acoustic gap, generate an electro-magnetic field between said electrodes causing an excitation voltage within a vibrating area of said resonator plate, that generates an acoustic energy within said resonator plate; and

said resonator having a resonator frequency determined by said resonator thickness dimension, t_3, said resonator area provides an active element trapping said acoustic energy, causing said acoustic energy to be confined to said resonator area to minimize a leakage of said acoustic energy and provide a high Q factor at 3GHz.

13. The single-sided electrode-free resonator device, as recited in claim 12, further comprising said top electrode having an electrode length, l_2, and an electrode width, w_2.

14. The single-sided electrode-free resonator device, as recited in claim 13, further comprising said resonator having a resonator length, l_3, and a resonator width, w_3.

15. The single-sided electrode-free resonator device, as recited in claim 14, further comprising said bottom electrode having said electrode length, l_2, and said electrode width, w_2.

16. The single-sided electrode-free resonator device, as recited in claim 15, further comprising said electrode length l_2 being greater than said resonator length l_3.

17. The single-sided electrode-free resonator device, as recited in claim 16, further comprising said electrode width w_2 being greater than said resonator width w_3.

18. The single-sided electrode-free resonator device, as recited in claim 17, further comprising adjusting said resonator thickness dimension, t_3, to vary said resonator frequency.

19. The single-sided electrode-free resonator device, as recited in claim 18, further comprising fabricating said resonator plate with an etching process.

20. The single-sided electrode-free resonator device, as recited in claim 19, further comprising said resonator plate being composed of quartz.

21. The single-sided electrode-free resonator device, as recited in claim 20, wherein said resonator plate is a quartz crystal.

22. A double-sided electrode-free filter device, comprising:

a double-sided mesa resonator plate with a top surface, a top well, a plurality of mesas, a bottom well and a bottom surface;

a top electrode, being deposited on said top surface and having a top narrow portion and a top wide portion, extends into said top well surrounding said plurality of mesas, allowing said plurality of mesas to protrude upwards;

a bottom electrode, being deposited on said bottom surface and having a bottom narrow portion and a bottom wide portion, extends into said bottom well surrounding said plurality of mesas, allowing said plurality of mesas to protrude downwards;

said plurality of mesas providing an electrode-free resonator area;

a plurality of filters are provided on each of said plurality of mesas and are separated by a resonator gap, l_7, each of said plurality of filters having a top filter portion, a bottom filter portion and a resonator thickness dimension, t_3, measured from said top filter portion to said bottom filter portion;

an exposed top portion of each of plurality of mesas situated between each of said plurality of filters and said resonator area defines a top acoustic gap, l_4, and an exposed bottom portion of each of the plurality of mesas situated between each of said filters and said resonator area defines a bottom acoustic gap, l_4;

said top electrode and said bottom electrode, being acoustically coupled and controlled by said top and bottom acoustic gaps, l_4, generate an electro-magnetic field between said electrodes, causing an excitation voltage within a vibrating area of said resonator plate that generates an acoustic energy within said resonator plate; and

each of said plurality of filters having a resonator frequency determined by said resonator thickness dimension, t_3, said resonator area provides an active element trapping said acoustic energy, causing said acoustic energy to be confined to said resonator area to minimize a leakage of said acoustic energy and provide a high Q factor at 3GHz.

23. The double-sided electrode-free filter device, as recited in claim 22, further comprising said top electrode having an electrode length, l_2, and an electrode width, w_2.

24. The double-sided electrode-free filter device, as recited in claim 23, further comprising said plurality of filters having a resonator length, l_3, and a resonator width, w_3.

25. The double-sided electrode-free filter device, as recited in claim 24, further comprising said bottom electrode having said electrode length, l_2, and said electrode width, w_2.

26. The double-sided electrode-free filter device, as recited in claim 25, further comprising said electrode length l_2 being greater than said resonator length l_3.

27. The double-sided electrode-free filter device, as recited in claim 26, further comprising said electrode width w_2 being greater than said resonator width w_3.

28. The double-sided electrode-free filter device, as recited in claim 27, further comprising adjusting said resonator thickness dimension, t_3, to vary said resonator frequency.

29. The double-sided electrode-free filter device, as recited in claim 28, wherein said plurality of filters is two filters.

30. The double-sided electrode-free filter device, as recited in claim 29, further comprising fabricating said resonator plate with an etching process.

31. The double-sided electrode-free filter device, as recited in claim 30, further comprising said resonator plate being composed of quartz.

32. The double-sided electrode-free filter device, as recited in claim 31, wherein said resonator plate is a quartz crystal.

33. A single-sided electrode-free filter device, comprising:

a single-sided monolithic mesa resonator plate with a top surface, a well, a plurality of mesas and a bottom surface;

a top electrode, being deposited on said top surface, extends into said well surrounding said plurality of mesas, allowing said plurality of mesas to protrude upwards, and provide an electrode-free resonator area;

a plurality of filters are provided on each of said plurality of mesas and are separated by a resonator gap, l_7;

each of said plurality of filters having a resonator thickness dimension, t_3, measured from said plurality of filters to said bottom surface;

a bottom electrode, having a narrow portion and a wide portion, is deposited on said bottom surface;

an exposed portion of each of said plurality of mesas being situated between said plurality of filters and said resonator area define an acoustic gap, l_4;

said top electrode and said bottom electrode, being acoustically coupled and controlled by said acoustic gap, l_4, generate an electro-magnetic field between said electrodes, causing an excitation voltage within a vibrating area of said resonator plate that generates an acoustic energy within said resonator plate; and

each of said plurality of filters having a resonator frequency determined by said resonator thickness dimension, t_3, said resonator area provides an active element trapping said acoustic energy, causing said acoustic energy to be confined to said resonator area to minimize a leakage of said acoustic energy and provide a high Q factor at 3GHz.

34. The single-sided electrode-free filter device, as recited in claim 33, further comprising said top electrode having an electrode length, l_2, and an electrode width, w_2.

35. The single-sided electrode-free filter device, as recited in claim 34, further comprising said plurality of filters having a resonator length, l_3, and a resonator width, w_3.

36. The single-sided electrode-free filter device, as recited in claim 35, further comprising said bottom electrode having said electrode length, l_2, and said electrode width, w_2.

37. The single-sided electrode-free filter device, as recited in claim 36, further comprising said electrode length l_2 being greater than said resonator length l_3.

38. The single-sided electrode-free filter device, as recited in claim 37, further comprising said electrode width w_2 being greater than said resonator width w_3.

39. The single-sided electrode-free filter device, as recited in claim 38, further comprising adjusting said resonator thickness dimension, t_3, to vary said resonator frequency.

40. The single-sided electrode-free filter device, as recited in claim 39, wherein said plurality of filters is two filters.

41. The single-sided electrode-free filter device, as recited in claim 40, further comprising fabricating said resonator plate with an etching process.

42. The single-sided electrode-free filter device, as recited in claim 41, further comprising said resonator plate being composed of quartz.

43. The single-sided electrode-free filter device, as recited in claim 42, wherein said resonator plate is a quartz crystal.

44. A MEMS electrode-free ring electrode resonator, comprising:

a double-sided mesa resonator plate with a top surface, a top opening, a mesa, a bottom surface and a bottom opening;

a top ring electrode is disposed in said top opening, said top opening, said top ring electrode and said mesa being circular and concentrically aligned on said top surface, said top opening encircles said mesa, allowing said mesa to protrude upwards;

a top acoustic gap, l_1, separates said top ring electrode said mesa;

a bottom ring electrode is disposed in said bottom opening, said bottom opening, said bottom ring electrode and said mesa being circular and concentrically aligned on said bottom surface, said bottom opening encircles said mesa, allowing said mesa to protrude downwards;

a bottom acoustic gap, l_1, separates said bottom ring electrode said mesa;

said mesa defines a central electrode-free resonator area;

a resonator is located in said central resonator area, said central resonator area having a top resonator portion, a bottom resonator portion and a central resonator area thickness dimension, t_3, measured from said top resonator portion to said bottom resonator portion;

said central resonator area thickness dimension, t_3, being greater than a plate thickness dimension, t_2;

said top ring electrode and said bottom ring electrode, being acoustically coupled and controlled by said top and bottom acoustic gaps, generate an electro-magnetic field between said electrodes causing an excitation voltage within a vibrating area of said mesa resonator plate that generates an acoustic energy within said mesa resonator plate; and

said resonator having a resonator frequency determined by said central resonator area thickness dimension, t_3, said central resonator area provides an active element trapping said acoustic energy, causing said acoustic energy to be confined to said central resonator area to minimize a leakage of said acoustic energy and provide a high Q factor at 3GHz.

45. The MEMS electrode-free ring electrode resonator, as recited in claim 44, further comprising said top electrode having an electrode diameter, d_2, and an electrode width, w_1.

46. The MEMS electrode-free ring electrode resonator, as recited in claim 45, further comprising said central resonator area having a central resonator area diameter, d_3, and said central resonator thickness, t_3.

47. The MEMS electrode-free ring electrode resonator, as recited in claim 46, further comprising said bottom ring electrode being configured the same as said top ring electrode.

48. The MEMS electrode-free ring electrode resonator, as recited in claim 47, further comprising said bottom ring electrode having said electrode diameter, d_2, and said electrode width, w_1.

49. The MEMS electrode-free ring electrode resonator, as recited in claim 48, further comprising adjusting said central resonator area thickness dimension, t_3, to vary said resonator frequency.

50. The MEMS electrode-free ring electrode resonator, as recited in claim 49, further comprising fabricating said mesa resonator plate with an etching process.

51. The MEMS electrode-free ring electrode resonator, as recited in claim 50, further comprising, said resonator plate being composed of quartz.

52. The MEMS electrode-free ring electrode resonator, as recited in claim 51, wherein said resonator plate is a quartz crystal.

53. The MEMS electrode-free ring electrode resonator, as recited in claim 55, further comprising, said double-sided mesa resonator plate being rectangular.

54. The MEMS electrode-free ring electrode resonator, as recited in claim 53, further comprising, said double-sided mesa resonator plate being square.